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I've been consulting on environmental issues for the secondary lead industry for twenty years, and over that time, I've had the pleasure of working for every company that currently operates one of the fourteen secondary lead smelters in the United States. One of the main things that I've learned over that time, I've done mostly air pollution work, but also hazardous waste work, is that the issues across air, land, and water, are all related. If I'm going to help a client control their sulfur dioxide emissions and recommend a wet scrubber for sulfur dioxide, I'd better take into consideration what they will do with the water that comes from that scrubber. So it's all a multimedia interactive consideration, so while the bulk of this talk is going to be on air issues, I want to talk a little bit at the beginning about land impacts and water, and topics that Terry just covered as well.

For land impacts, it's how does one properly store the batteries that come to a recycling facility, how does one store the intermediate materials, the paste and the grids that come from the spent batteries, the handling of acid varies from some facilities reclaim and regenerate new acid, other facilities simply treat the acid as part of their wastewater process, other facilities take that acid and produce sodium sulfate crystals for sale. Again, there are a variety of options, but all towards recycling. With most on the land impacts is just the consideration of surfaces and floors and containment for managing those types of impacts. Water impacts, that's a very large issue to make sure the areas are contained with good, impervious surfaces, and at almost all of the U.S. secondary lead facilities, rainwater that falls on the facility is captured and treated prior to discharge. And on air impacts, as I talk about them, while the focus is primarily on air impacts from lead emissions, one must also consider other pollutants that are generated by these recycling processes: sulfur dioxides, nitrogen oxides, and others. On air pollution control from secondary lead smelters, and really from any process, it's approached from various levels, both regulatory and from a design perspective. We start first for limitations at the point of release, at the stack emission point, the limitation in the United States for secondary lead smelter is that the exhaust gases at the point of release can contain no more than 2mg per dry standard cubic meter of emissions. So that's an emission at the point of release. Also in the U.S. and in Mexico, the current ambient air quality standard out in the community near the facilities is a limitation of 1 ½ mcg per cubic meter. We'll talk more later that that standard may be changed in the U.S. shortly. Also, ozone standards and particulate matter standards in the surrounding community also work backwards like that ambient lead standard to a facility and may say that a facility may have to do better at its point of release than the 2mg per dry standard cubic meter in order for the ambient levels in the community to meet the acceptable standards, so those all work together. And primarily in the U.S., because of so much litigation in the U.S., other considerations from air are litigation from neighbors, claims that they've been damaged by a facility's releases, the accumulation of lead bearing dust and community soils becomes an issue, so that's another part of that theme, sometimes air emissions, if they're not managed properly, can become issues with other media, like the soils around a facility.

This slide just shows a basic block diagram of a secondary lead facility. Beginning with the battery breaking and crushing operation, and then an intermediate step called paste desulfurization. It's not universal, not everybody does it, but it's quite common, especially at the facilities in the U.S., to take the paste that comes from the broken spent lead acid batteries, which is primarily lead sulfate, and react that with either soda ash, or sodium hydroxide, to produce, to convert that lead sulfate to a lead oxide or a lead carbonate before that goes to the smelting furnace. That has a benefit of reducing the amount of waste slag from the operation, but also is itself a great control method for the reduction of sulfur dioxide emissions from these facilities, so I've got it in the basic flow diagram, even though that step itself is somewhat of an air pollution control mechanism that can be 60-70% effective in the reduction of sulfur dioxide emissions. It's interesting, I mentioned the off the battery crushing, one can either treat the acid or produce sodium sulfate crystals or reclaim it, I was at a facility once in Czechoslovakia, where I started to ask them, I've finished the plant tour, and I asked them, “Well, where’s your wastewater treatment operation?” It goes back through the translator, and it comes back, “what wastewater treatment operation?” I said, “Well, how do you deal with the acid?” Goes back through the translator, comes back, “We’ve never seen any acid here.” They had never received a full battery. The practice in that country was to drain the batteries before they ever entered the recycling chain. So hopefully that is no longer the case there, I know it’s the practice here in the U.S. that batteries are typically received full, but kind of a scary story from that. Also in the block diagram, I have, in the lower portion, that the waste slag can sometimes be treated to render it non-hazardous, to reduce the leachability of lead, not all facilities have to take that step, and not all facilities that have to take that step do that on site, but we’ll talk about that as well, and this block diagram is kind of generic, there’s differences, the RSR facilities, for example, the slag from the reverbatory furnace is handled with an electric arc furnace instead of a blast furnace, but they’re the only company that does that, the more typical configuration is to use a blast furnace for that step, but in a generic sense, this is an overview of the various processes that we will walk through, how the emissions are controlled. Always like to start at the beginning, material comes in, the batteries are broken up, and at most facilities, the desulfurization process is performed to remove as much sulfur from the paste at the front end. At some, not all, facilities, there is a wet scrubber, on those various processes, to collect any sulfuric acid missed that’s liberated from the crushing process, and any lead bearing dust from the processes.

And now pictures (on slides), it’s a whole lot better than words. This is a picture from an older facility, that this is the hammer mill that breaks the batteries, and then the subsequent separation steps, this facility does not have a scrubber to control those operations, air emissions, however, you note that the operations are enclosed in a relatively tight building to minimize the fugitive emissions, so even at this older and smaller facility, the battery breaking and crushing operation is not outdoors or exposed to the elements in any way. By contrast, this is a much larger and newer facility, where again, the whole operation is enclosed in a building, but also, there is a scrubber. This is part of the duct work leading to that scrubber, that is collecting sulfuric acid missed and lead bearing dust and mist from the processes. These are the desulfurization reaction tanks to that facility where the lead bearing, lead sulfate paste is reacted to produce lead carbonate, in this case, and you’ll notice, the duct work leading to the scrubber that comes from the top of each of those tanks, so that any, as the tanks are filled, any displaced air is scrubbed and treated. And at the same facility, this is the scrubber, you can see (on slide), it’s a rather large duct work by the time everything comes together to remove that mist and then exhaust through the roof to the atmosphere. The themes in this process are not any different from any of the other downstream processes. In general, it’s the overall enclosure of the operation in the building, and then putting in ventilation devices to collect emissions at the point of generation as much as possible so that, while yes, the building encloses everything, you wouldn’t want to rely on the building to be your main emission capture point, because you would be allowing the workers to be exposed to everything if you did that. By putting more at the source, you solve the worker protection problem and the atmospheric emission problem at the same time. Once the batteries have been broken and the acid has been removed, the lead bearing feed materials are typically staged in a bunker or a feed room that has a well constructed impervious floor, and those materials are typically moist or wet, such that there’s not a whole lot of dust or lead bearing air emissions from those operations, but in the best practices, in the state of the art facilities, you’ll find that the storage of these intermediate materials after the battery breaking process are ventilated, enclosed, and the building’s maintained under negative pressure with the exhaust going through a back house for filtration. Again, that’s not universal, but in the most tightly controlled facilities in the states, you will find that intermediate level control. And that’s more in recognition that there’s a lot of manual handling and a lot of mobile equipment in those operations, and as the stored material dries out, if it stays there for a long time, it does get dusty, and it doesn’t always maintain the initial moisture level that prevents emissions in the first place.

This is not really related to air pollution control, but it’s an interesting slide from the worker protection standpoint. This is a front end loader that operates in one of those feed rooms, and you’ll notice that atop the loader, there is an air filtration operation, that is a, the HEPA filter so that the supplied air into that worker’s cab is a filtered clean air environment for that worker. Most of the facilities that operate the reverbatory furnaces will operate a feed dryer ahead of that furnace. Again, that’s not a universal practice, not really a picture to show of this, it’s not terribly exciting, but the dryer would be a rotating kiln to dry the feed material before it hits the main smelting furnace. Those, that dryer’s exhaust, of course, has to go to a bag house and the emissions filter. One initial note of care about those feed dryers that I encountered, probably 10 years ago at a facility, was to take care with the design of the arrangement of the heating burners in that dryer so that the chances of direct flame impingement from the burners onto the feed material was prevented, this facility was actually encountering situations where the polyethylene separator material from the batteries that was going through the dryer was actually being combusted in the dryer instead of just heated, and the direct burning of the polyethylene there was leading to some pretty odorous emissions downstream in the facility and leading to a lot of neighbor complaints. We rearranged things and got that fixed, but it was kind of a detective story at the time, it was “Where’s that smell coming from? Where the real action is in these facilities is in the smelting furnaces. The typical facility having a reverbatory furnace up front that takes the lead bearing paste and the grid metal to produce a soft lead, one with very low antimony, almost pure lead, and then the slag from that furnace is, along with scrap from the battery manufacturing facilities, is processed in the blast furnace to produce a more antimonial or hard lead. Beyond the direct process emissions from these two furnaces that we’ll address later, a lot of care is made to the hooding of the access, the input and output points, the charging and tapping points, to those furnaces, to prevent fugitive emissions that escape and expose the workers, or release into the outside atmosphere. This is a side view of a reverbatory furnace at a very large modern secondary lead smelter in the U.S. This is on the slag tapping side of the furnace, this is where the slag is tapped from the furnace, it’s a large rectangular refractory line vessel. You’ll notice that the worker can see through here to the tap and reach in through a rod to make things happen, but it’s very tightly enclosed and a rather large duct with a lot of ventilation being applied to that point to not only prevent releases into the end plant environment for the workers, but also to minimize releases to the atmosphere. In addition to this closed hooding, the operation itself is in a building which is fully enclosed and maintained under negative pressure, and the exhaust from that building ventilated through a bag house itself. So the chances for emissions from this operation are quite small.

This is one of the side burners to that furnace. This is the same furnace on the other side. This is where the soft lead is tapped from the furnace. You notice they have the molds on a moving track, the hood stays in place, and the worker’s quite removed from direct exposure to the degree possible. This is at an older facility, a blast furnace, but even at this older facility, you’ll note that the slag tapping operation off the blast furnace is pretty well hooded, that goes to a relatively large duct to minimize fugitive emissions when the slag is tapped from that furnace, you’ll notice this is the charge chute for taking the feed material up to the top of the blast furnace, I’ve got another view in the next slide, this is totally enclosed, and negative pressure maintained on that charge chute. It’s particularly important to hood this furnace as much as possible at the sources, because if you can tell from the lighting, I’m actually standing outside to take this picture. This particular furnace is not enclosed completely in a building, and any fugitive emissions that this hooding does not collect are going to escape the facility and impact the ambient environment nearby, so hooding close at the source is doubly important at this facility, because there’s no second line of defense. A poorly lit slide, but this is the same furnace showing the feed table and the charging chute going to the top of the blast furnace. Leaving that to a larger facility, more modern blast furnace, this is the slag removal side of the blast furnace, you’ll note the molds are, again, are moved into place with a stationary hood that has a rather large duct.

Dan Askin will be talking more about worker protection, but you’ll notice that this fellow’s in a full-face respirator, has a lot of good personal protective equipment on to do his job in a safe fashion. This is the same blast furnace from the lead tapping side, again, similarly, the molds are moved into place under the stationary hood, rather large duct work with a pickup at this point, a pickup here at the point of the mold itself. In additional steps, this facility has, both from a worker protection standpoint, and to prevent fugitive emissions to the atmosphere, you’ll notice that the tweers[??] on this blast furnace are fitted with automatic punchers, those of you who know how blast furnaces operate, rather than have a worker manually punch those holes open to allow the blast airflow into the bottom of the furnace, that process is automated with hydraulically driven punches, and so the worker does not have to face the potential of direct blowback out of that furnace and all the dust associated with that. Now the direct emissions from the furnaces themselves, there’s a wide variety of ways those are handled in the states. The blast furnaces, by their very nature, are very reducing atmosphere. A lot of incomplete combustion in those furnaces, a lot of carbon monoxide emissions, a lot of volatile organic compound emissions, so the blast furnaces are always fitted with an afterburner to provide those three T’s: time, temperature, and turbulence, and I always add an extra piece: excess air, to make sure that carbon monoxide is driven to carbon dioxide, and that those incompletely combusted organic materials from the blast furnace are more fully combusted.

I did have a case about 10 years ago, again, with a facility where, the facility was encountering very large carbon monoxide emissions after the afterburner, and we looked, the temperature was quite high, the resonance time was fine, the turbulence, why are we not getting any destruction? And it was because somebody had changed some of the dampering and the gating, there was no excess air going in, so that old adage of time, temperature, and turbulence is not always enough, if there's not any extra oxygen there to do the job to convert the carbon monoxide to carbon dioxide. It's also, at some facilities, and it's become an EPA recommendation to, instead of a separate burner, chamber afterburner, at facilities that have both reverbatory furnaces and blast furnaces, there's a concept of taking the exhaust gases from both of those furnaces together into a common chamber that blends that air, because there's enough temperature in the reverbatory furnace off gases to do the job that the auxiliary burner in the afterburner would usually do. That's kind of an emerging approach, if it works, not terribly well in retrofit situations because the furnaces have to be arranged and close enough together to make it work, but in newer designs, that's an attractive newer design, because one, it eliminates the need for an extra burner here, saves natural gas combustion, which is not an insignificant cost at these facilities. We've talked earlier about the pace desulfurization getting 60-70% sulfur dioxide control just inherent to the process, depending on the jurisdiction that the facility's located in, that may or may not provide enough sulfur dioxide control for the local air authorities, so following the lead and particulate emission control bag house, there may also be a sulfur dioxide scrubber in addition to this step to provide further sulfur dioxide control, and those could either be wet scrubbers, there are facilities that do dry scrubbing, the dry injection of sodium carbonate to accomplish that goal, and some facilities are also looking at some novel controls after the bag houses, because their jurisdictions are requiring further control for particulate matter, things like electrostatic precipitators are even being looked at downstream.

To look at those process off-gas operations, this again is the older facility of the two that I've shared pictures with you on. Remember, I said before, when I was looking at the blast furnace, I was actually standing outside, I took the picture from where that truck is looking at the blast furnace. The blast furnace is behind here, this is the direct off gas coming down to an afterburner chamber, then going up, going through radiant coolers to cool the air passively before it goes through the bag house, a shaker type bag house here, and then the exhaust stack to the atmosphere. Notice, and I'll show it on another view as well, this stack, and all the ones you'll see have platforms to access for stack testing, and this particular facility, you can see there, also has a continuous emission monitor for the sulfur dioxide emissions, so the sulfur dioxide emissions are continuously monitored. This is in a jurisdiction where sulfur dioxide is of concern to the facility, and again, this is not the only way this can be done, there are facilities that, instead of the radiant type passive cooling, can employ a water spray directly in the airflow to cool the exhaust gases, but they have to be cooled in some fashion, because at this point they're way too hot to go into the bag house. Again, we noted before, this facility is not totally enclosed, so measures to prevent other emissions to the atmosphere are just that much more important at this facility. Note the puddle here, it hadn't rained at that facility for days when I took this picture. That puddle remains because this facility regularly employs water sprays to regularly wet the yard surfaces almost continuously so that the yard surfaces paved areas never dry out. That is a very effective measure to prevent any dust, any lead bearing dust that's tracked into the yard from becoming airborne. It's been effective for that facility. It goes without saying, all of the plant operational area is fully paved, there's no exposed soil or dirt as emission control, and also note that beneath the bag, the cooling area, I've got another shot later, beneath one of the bag houses, you'll note pretty substantial curbing so that any dust falling from the conveyant screw conveyors, or any, the dust collection itself, after the bag houses, any spills are contained in a smaller area and not allowed to spread over the wider yard. Note again, the test platform, and the continuous emission monitor, the radiant cooling, and the shaker type bag house for those blast furnace emissions. The bullion from these two types of furnaces goes to a refining area, these are typically natural gas fired kettles, vessels in which the bullion is refined to remove impurities or add alloying elements to achieve the desired specifications for the product lead. Typically, though, these operations, the kettles themselves are hooded and ventilated to a bag house. No one really controls (go back a little bit), kind of a side thought, no one really controls directly for nitrogen oxide emissions that come from the refinery where one typically adds sodium nitrate to the kettles for softening, and no one can control those NOx emissions because of the temperatures involved, but from a pollution prevention aspect, I worked with a client that, they were having some situations where sometimes the operator got lazy and was just taking a whole bag of the sodium nitrate and tossing it in the kettle, which is not the way to do it. One should meter it in slowly to make it do its job better, and when you just slug it in that fashion, they were getting kind of a brown cloud off of their stack, complaints from the neighbors, we actually went in, and they fabricated some hoppers for the sodium nitrate with a screw conveyor in the bottom, electrically driven, so that they would take that hopper and meter that material in at a defined rate. The brown cloud went away, but also more importantly, they found after they implemented that for several months, they had reduced their usage of sodium nitrate by, like, 30%, because they were just wasting it right up the stack, it was a very effective measure. Of course, the lead emissions are the thing people think about the most, and this is a hooding of the refining kettle itself. Note that the bin for collecting the dross off the kettle is enclosed, has its own ventilation line to keep this under negative pressure and an in-draft of air at the dross collection point. Note this facility, this is wide open to the outside as well, so this is not a totally enclosed facility, whereas best practice would have it enclosed as well. This particular, this next facility does have it fully enclosed. You'll note a pretty close fitting hood on the kettle itself, and the next slide, you'll see the dross collection bin with a pretty substantial ventilation on it, and again, in Dan's topic later, you'll note the worker in a full face respirator.

This is back to the facility that is not fully enclosed, this is the refinery underneath this roof right here. A pulse jet type bag house, in this case, again with the testing ports and platforms on the exhaust stack, and again, notice the very substantial wall around the base of this bag house so that the dust that's collected from the bag house, any spillage from that area is maintained in one small area where it can be cleaned up and doesn't get into the larger plant yard, which again, is paved, see the puddles from the wet suppression to keep the fugitive emissions down. I mentioned earlier, some facilities, the waste slag from the blast furnace or electric arc furnace is sometimes a hazardous waste due to the leachability of the lead from that slag, some facilities will treat that slag on site, it's not a very fancy process, the slag is crushed and mixed with cement, lime, or other materials to reduce the leachability of the slag, the emission controls from that is pretty simple, it's, you know, just hooding of the crushing operation and the mixing operations and the ventilation of that to a bag house. It's kind of a repetitive theme: enclose it, ventilate it, filter it. It's not terribly fancy. As the final step, and I've alluded to this before, in addition to all these systems that we've already talked about that address the individual processes themselves, it's, in the overall emerging state of the art, would be to go beyond that and enclose at least these operations here within buildings, then the buildings themselves, maintained under a negative pressure by a ventilation exhaust system that's filtered by its own bag house or cartridge collector as an additional step. This becomes a bigger issue, I think typically, if the smaller the piece of property that the facility is located on, because what drives these systems are the, meeting the emission control standards from the processes themselves. This auxiliary system is something that a facility would add if they've got a very small piece of property, and because of that, they're having difficulty meeting the ambient air quality standards in the neighboring air, because in their case, with small property, the neighboring air is so very close, and this additional step is to enclose all of these processes in a building and maintain suction on those buildings.

This is a photograph of an example system that I designed for a client in the early 1990s for the ventilation of a building that enclosed two reverbatory furnaces and a blast furnace. This system is about 150,000 ft3 per minute of air going through cartridge collection devices. The cartridge collector is probably not the desired way to go for direct process emissions or really high loading, but in this situation where it's just taking the building air and a couple of hoods on some particularly dry dusty processes, it works very well, you're able to get a lot more airflow through a lot smaller cabinet with a lot smaller footprint. Again, 150,000 cfm just to maintain their buildings under negative pressure, notice the testing ports, and the system's still in use, while we designed it in the early 90s, this picture was taken last month, so it's still going well. A little closer shot of the same system, and all the processes we've covered. As I mentioned, sort of that double layer of regulation, and that double layer leading to double layers of design, there's dealing with direct emission standards and obligations with the emission controls of the exhaust points themselves, and then there's that issue of dealing with the ambient air quality standards beyond the facility's fence line, and on those, it's no real surprise that these facilities, the bag house controlled and filtered stack emissions are almost never the problem in terms of ambient community impacts of lead. If there are issues with compliance with the local community ambient standards, it's because of what we call fugitive emissions at the facility. These are lead emissions that, for whatever reason, are not captured by that type of emission control system. And the control is the key to, in various mixes of these steps, dependent upon how large a piece of property the facility has, and it's other arrangements, to go beyond the direct source hooding and capture, to enclose the processing operations and buildings, elimination of outdoor transfers is a very large issue, if you've got a choice of having your smelting furnaces in one building and the refinery in another building, if you've got to manually transfer that material back and forth outside between the buildings, it would certainly be preferable to have it all under one roof so that, yes, those transfers still occur, but you're not going in and out all the time. Easier said than done in a retrofit situation, in a new plant design, almost all the new things being considered are kind of integrated buildings such that things don't go outside once they go in the process, it's indoors from then on. That's the ideal, you don't always get that luxury at an existing facility. Control of tracking of dust onto road and yard surfaces. We'll talk about this some more next, the U.S. federal standard, the national emission standard for hazardous air pollutants for the secondary lead industry has specific requirements that require the wheels of any vehicles leaving the lead processing area to go outside of the building, that the wheels have to be washed before that vehicle leaves the processing area. That's a forklift or a front-end loader in the building. Before it goes back outside, those wheels have to be washed to prevent the tracking of the lead bearing dust onto the surrounding paved yard area where other traffic can kick that dust back up and lead to emissions. Of course, paving of the road surfaces is the key, and then depending on the facility, the degree to which one needs to do this, to regularly clean or wet those yard surfaces to minimize the chance that any deposited or tracked dust gets kicked back up to the atmosphere. This is a photo which accomplishes two things, this is the wheel washing station at a facility, this is the processing area up here, any vehicles, front-end loaders, forklifts, other vehicles leaving the facility have to pass on these two grates which have drains under them, and the wheels washed off before that vehicle can proceed and leave the facility and potentially track lead onto the areas, and this device is a HEPA filter vacuum sweeper for use indoors and out on the plant yard.

Talked a little bit about kind of another line of defense that's required by the regulations and can also be used to diagnose things. Continuous emission monitors are often employed at facilities. You find that, pretty common for nitrogen, sulfur dioxide emissions, that facilities where the sulfur dioxide is tightly regulated to the degree that the facilities have to have wet scrubbers as well, it's not uncommon for the agencies to require continuous monitoring of the sulfur dioxide emissions. Nitrogen oxide emissions is not uncommon either. What is common and required everywhere is regular monitoring of the temperatures in those afterburner chambers to make sure that sufficient temperature is maintained, to destroy the carbon monoxide, and any organic hazardous pollutants. The pressure drop on the bag houses, regular monitoring to make sure that they're within specification, and broken bag detection systems are required on the U.S. smelters, these are various technologies, but in all cases, they are designed such that if there is a bag break in one of those bag houses, that the exhaust is continuously monitored in a fashion to detect that break and signal the operators to take action to replace that broken bag. Ambient air monitoring, of the 14 secondary lead smelters currently operating in the U.S., 12 of the 14 have ambient lead monitors very near to their facilities, these are operated either every sixth day on a federal schedule, or in some jurisdictions, every day, and variations in between, to measure the ambient concentration of lead in the atmosphere in the facilities, for comparison with the federal or state ambient air quality standards. So beyond these steps, which monitor at the source of release, the facilities are very tightly monitored for the results and the effect of all their efforts in the neighboring community, and again, depending on the size of the facilities' property, can vary just how close those monitors are to the facility, and how likely they are to be impacted by dust spills or other things, for an example, the facility that we showed you, remember the blue stack earlier, this is the plant building, this is a public road, and there's the two ambient monitoring stations, so they are extremely close to the facility, so that's not an uncommon situation in the U.S. to find these monitors for determining the atmospheric lead that close. I mentioned earlier at the beginning that the ambient air quality standard in the U.S. is undergoing a review. It will be, the proposal of any revised standard will be in March of 2008, and under court order, the final rule is to be issued by September of 2008. We were expecting an advanced notice of proposed rulemaking regarding this change last week, that deadline was not met by the EPA, we're expecting that this week, depending on which rumors you want to believe, there's a two-order of magnitude spread in the possible numbers, so we don't know exactly how that's going to come out, though the expectation is probably, more than likely, some reduction in this standard is more likely than not, and that will require additional measures at facilities that are, anybody that's just meeting this standard barely is going to have to do some more efforts in the, primarily in the fugitive emission control area to deal with that. I know, from what I've read that the Mexican standard is, is this same numerical value, I don't know how close the agencies work together and watch one another, but as the U.S. changes their standard by this date, it's not unreasonable that other jurisdictions around the world may follow. Additionally, climate change is a big issue around the world, it's becoming an issue in the United States, the only area where there's specific legislation regulation at the moment is in California, the two secondary lead smelters that do operate in California are in the category of a major facility such that they are going to have to participate in the first round of California's new regulations which will require reporting of their 2008 greenhouse gas emissions in 2009, so for now, that's the only regulation that's got any hard teeth yet, but legislation is brewing in the United States for greenhouse gas emission control all the time, and these facilities, depending upon where the thresholds are set, if California is any example, the lead recycling industry is facing potential regulation in this area as well, and the key there is energy efficiency. I don't think anybody operating a secondary lead smelter is burning any more natural gas than they just have to, the stuff's not cheap, so I don't know how much opportunity there is for reduction, but there's certainly an opportunity for regulation, even if there's no answers, unfortunately.

For information resources on the hooding and things, in the handouts and on the CD, there's a link to the Occupational Safety and Health Administration's website for the hooding of secondary lead smelting processes, Dan Askin will talk more extensively about that in his talk, and I mentioned the standards in the United States for emissions from the secondary lead industry, I give the link (on slide) to information regarding those standards, this is where you would find the mandates for afterburner operation, broken bag detection, the emissions standard of 2mg per dry standard cubic meter, all of that would be found in these regulations.